DØ TRD SYSTEM

GAS SYSTEM AND PROCESS CONTROLS UPGRADE

ENGINEERING NOTE
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TRD SYSTEM UPGRADE

TRD UPGRADE--SUMMER OF 1993

This Engineering Note includes the Following:

Section:

1. Upgrade Description.
2. Simplified control flow diagram.
3. PID Loop information.
4. Simplified control logic description.
5. Physical wiring details.
6. Operator Pictures.
7. I/O Map Ch#3, Ch#1(partial).
8. Platform U.P.S. backup time table.

Introduction:

DØ upgraded the TRD gas system and added the process control of TRD to the DØ Cryogenic/Gas control system. 70% of the TRD plumbing system was redesigned, installed and Helium leak checked. The preexisting basic control approach of using mass flow controllers to control chamber pressures was found to be a reliable control approach, this strategy was continued in the new control system.

The Flow Control is done by an industrial Programmable Logic Controller(PLC)(TI565T in our application) using a feedback PID (Proportional, Integral, Derivative) Process Control Loop for each flow controller. TRD uses nine of the available 64 preconfigured control loops. Loop input is chamber pressure. Loop output is the Flow controller command signal. Loop gains are completely programmable and tunable. Loop Process time can be set down to .1 seconds, however initial experience indicates that 1 second loop process times are sufficient.

One of the observed control problems was that there is a common return from the detectors which could set the system into oscillation. Part of the upgrade was to add separate return lines and back pressure regulators.

Detector Platform:

DØ installed an I/O base in relay rack PW-00(cryo) which is within about 20' of the TRD control devices on the platform. The remote base has one twinax link to the control system which multiplexes data to/from the I/O base at a speed of 2mbaud. This twinax link is isolated from ground which will not interfere with the electrical "floating" of the detector platform. Installing this I/O base allowed the removal of 10-15 cables that ran up to the TRD gas room and all of their optical isolation equipment.

An Uninterruptable Power Supply (U.P.S.) was installed in RR PW-00 with a 20 amp, 24vdc power supply for instrument and I/O base power. The U.P.S. is rated @ 1.7 KVA. See attached table for backup times.

The 9 pressure transmitters were replaced with industrial 4-20 ma pressure transmitters. The elevated signal allows the computer system to monitor for valid transmitter data.

The 6 Brooks mass flow controllers were removed and sent back to Brooks for factory calibration, then reinstalled.

The 3 variable solenoids that controlled Xenon flow were replaced with newly purchased Xenon Brooks mass flow controllers.

The platform plumbing stayed the same, however a thorough He leak checking revealed a number of large leaks in the existing plumbing. They were repaired.

The TRD chamber sets were not disturbed themselves. During the rebuilding period the chambers were all purged with low pressure gas flows.

TRD GAS ROOM:

The TRD gas room plumbing, instrumentation and controls part of the system were completely rebuilt. Two new stainless steel bellows pumps were added for reliability and purity. All of the plumbing in the TRD gas room was Helium leak checked.

The pressure transmitters were replaced with industrial 4-20 ma pressure transmitters. The elevated signal allows the computer system to monitor for valid transmitter data. Some of the 24vdc solenoid were reused. All of the wiring/cabling was replaced. A DMACS view was installed in the TRD room.

TRD DATA AND HIGH VOLTAGE:

TRD data used to be sent to the VME data acquisition system by a special program, written on a PC connected to the DØ IBM token ring network to a VME node. The upgrade transfers process data from the PLC directly to a VME node through an RS232 serial port. This serial port also transports Cryo, WAMUS, and SAMUS process data to the VME data acquisition system.

There was and is a High Voltage interlock from the TRD process control system. The process control system monitors process values such as flow, pressure, and H2O PPM and will open or close a relay on the Detector Platform when these process variables are in and out of tolerance. This is not a latching feature i.e. there is no reset. However once the High Voltage is shut down, shift personnel do have to reengage the TRD High Voltage system.

SUMMARY TABLE

Removed	Added
1. The Intel (control computer)	TI565T(exists)
2. The IBM (monitoring computer)	DMACS(exists)
3. Metrabus (I/O hardware)	TI I/O BASE
4. Pressure Transmitters on platform.	Industrial PT'S
5. Power supplies. DC and U.P.S.	10KVA U.P.S. (exists)
6. One diaphragm pump	Two on line bellows pumps.
7. Common detector flow return lines	Individual flow returns.
8. All cables and Wiring.	I/O base and device wiring
9. Token Ring data path to VME	TI Data Highway to VME
10. Xe Flow Control Variable Solenoids	Xe Mass Flow Controllers

What was not be removed:

1: Mass flow controllers. (However they were removed for Factory calibration)
2. Most of the Detector Platform plumbing.
3. Solenoids.
4. Chambers.
5. Chamber Pressure Reliefs.(Bubblers)
6. Gas analysis instruments.
7. Gas filter media.
8. The canary.

New system advantages:

1. Distributed control and alarms.
2. Historical trending and archiving.
3. Powerful historical display features.
4. Historical files can be transfered to common spreadsheet software.
5. Control will be done through graphic pictures that resemble flow diagrams, commonly refered to as point and click control.
6. Autodialer alarming will be available to the system.
7. Control power backup with generator backup.

8. Automatic on-line computer backup.
9. Control logic will be easily programmable through industrial software such as TISOFT and Application Productivity Tool.
10. A user friendly operating system for the operations group.
11. System security. Each system is password protected to avoid accidental or unauthorized access.
12. Reliability. All components of the control system have either on-line or off-line spares.
13. Backup on-line Xenon pump. Bellows pumps are less likely to leak than diaphragm pumps. The Bellows pumps should help control the purity of the Xenon.

COMPONENTS:

A. Texas Instruments 565T Industrial Programmable Logic Controller

Tasks:

1. PID Process Loop Control (all).
2. Vacuum system control.
3. Calorimeter cryogenic control.
4. ODH and ventilation monitoring and control.
5. Instrument air monitor and control.
6. Glycol cooling system monitoring and control.
7. WAMUS and SAMUS gas system process control.
8. *TRD gas system process control*

Specifications:

1. 8192 I/O points(Current use is 1024).
2. 64 PID Control Loops (Current use is 25).
3. 50,000 internal control relays (Current use is 1024).
4. Hot Backup(2 PLC's running in tandem)
5. 352K of memory (Current use is 96K).

B. Operator interface (DMACS-Distributed Manufacturing and Control Software).

DMACS is the current DØ operator interface software. It is a computer graphical environment from which the operators can monitor and control any process I/O connected to any of the PLC's through its data base. It can easily be expanded to accommodate the TRD gas system.

Tasks:

1. Display real time process data in graphic format.
2. Provide operator control of processes.
3. Provide process alarms.
4. Provide historical data storage and archiving.
5. Provide communications to all PLC's.

6. Provide networking to all DMACS nodes(distributed control).

7. Provide trend data display of processes.

Specifications:

1. Runs on DOS or VAX platform. Currently only DOS.
2. Database max size is dependent on RAM memory.
3. Graphic picture storage dependent on hard drive capacity.

DØ TRD PRESSURE/FLOW CONTROLS